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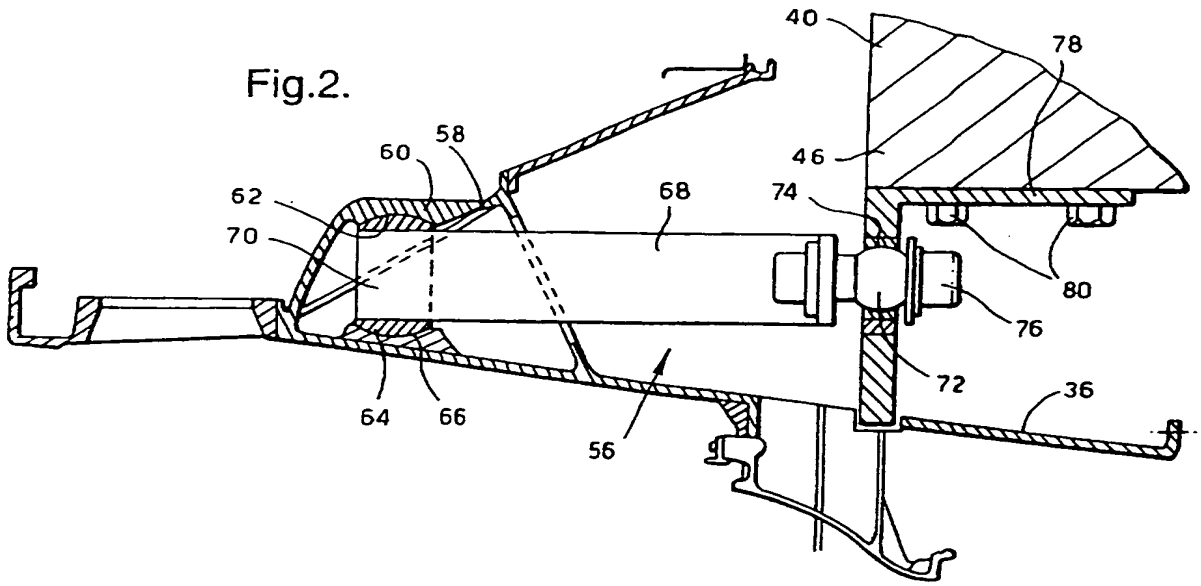
(54) Abstract Title

Aircraft turbofan gas turbine engine upstream core mounting which does not transmit vertical loads

(57) A mounting for coupling a turbofan gas turbine engine to an aircraft comprises a downstream core mounting (50, fig 1), a fan mounting (48, fig 1) and an upstream core mounting 56 which transmits side loads between the core casing 36 and the aircraft structure 40. The upstream core mounting 56 comprises a first structure 58 on the core casing 36 adjacent to a compressor section (16, fig 1). The first structure 58 comprising a sleeve 60 having a spherical inner surface 62 and a bush 64 having a spherical outer surface 66 which locates within the sleeve 60. A triangular second structure 68 has a pin 70 which locates coaxially in the bush 64, and has laterally spaced connectors (72,72B figs 3 and 4) to secure the second structure to the aircraft structure 40 to transmit side loads but not vertical loads. The connectors 72 may have spherical surfaces, or may be a pair of coaxial pins. This arrangement reduces wing flutter and allows engines to be changed simply.

Fig.2.



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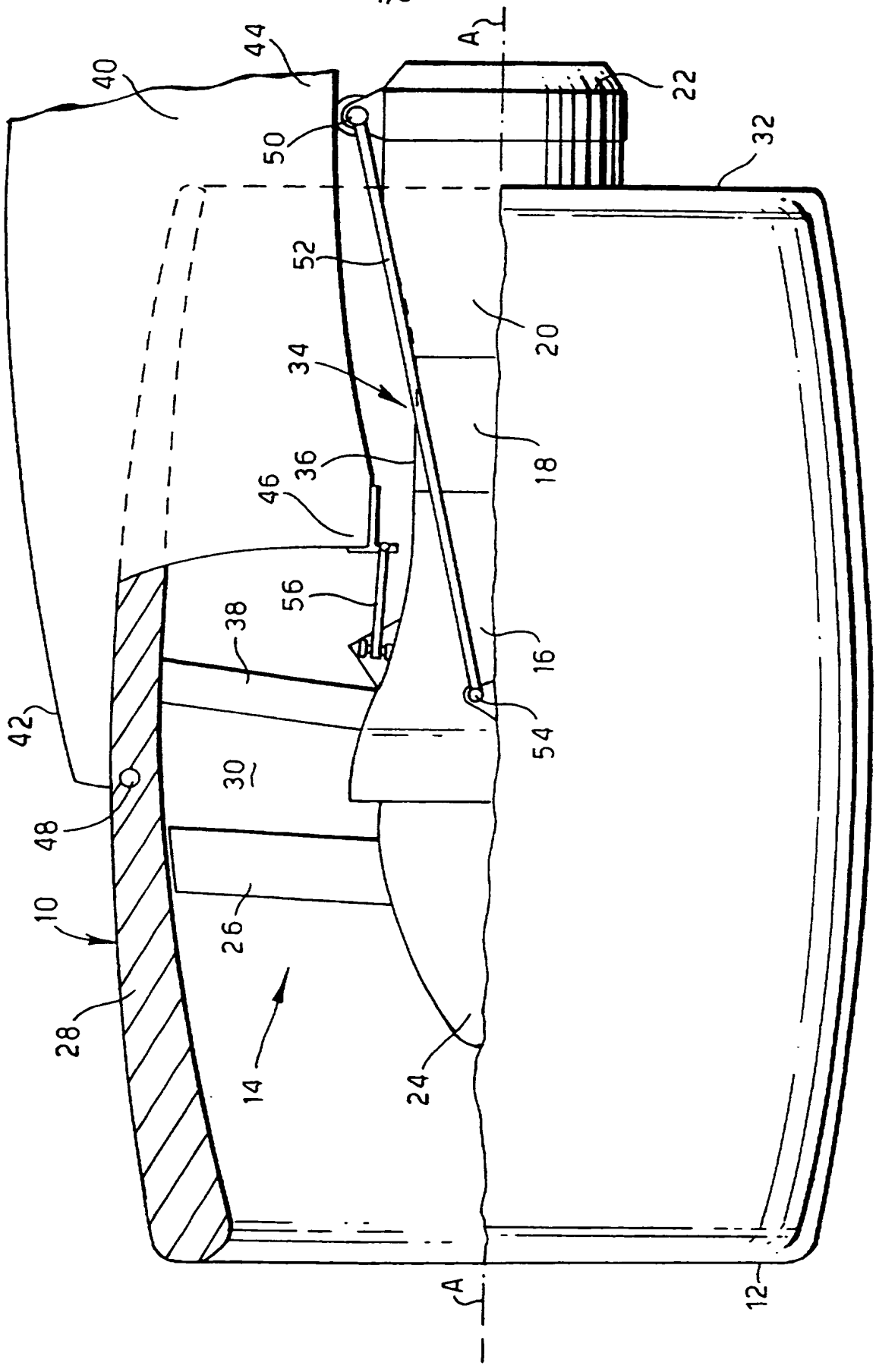
At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

Fig.1.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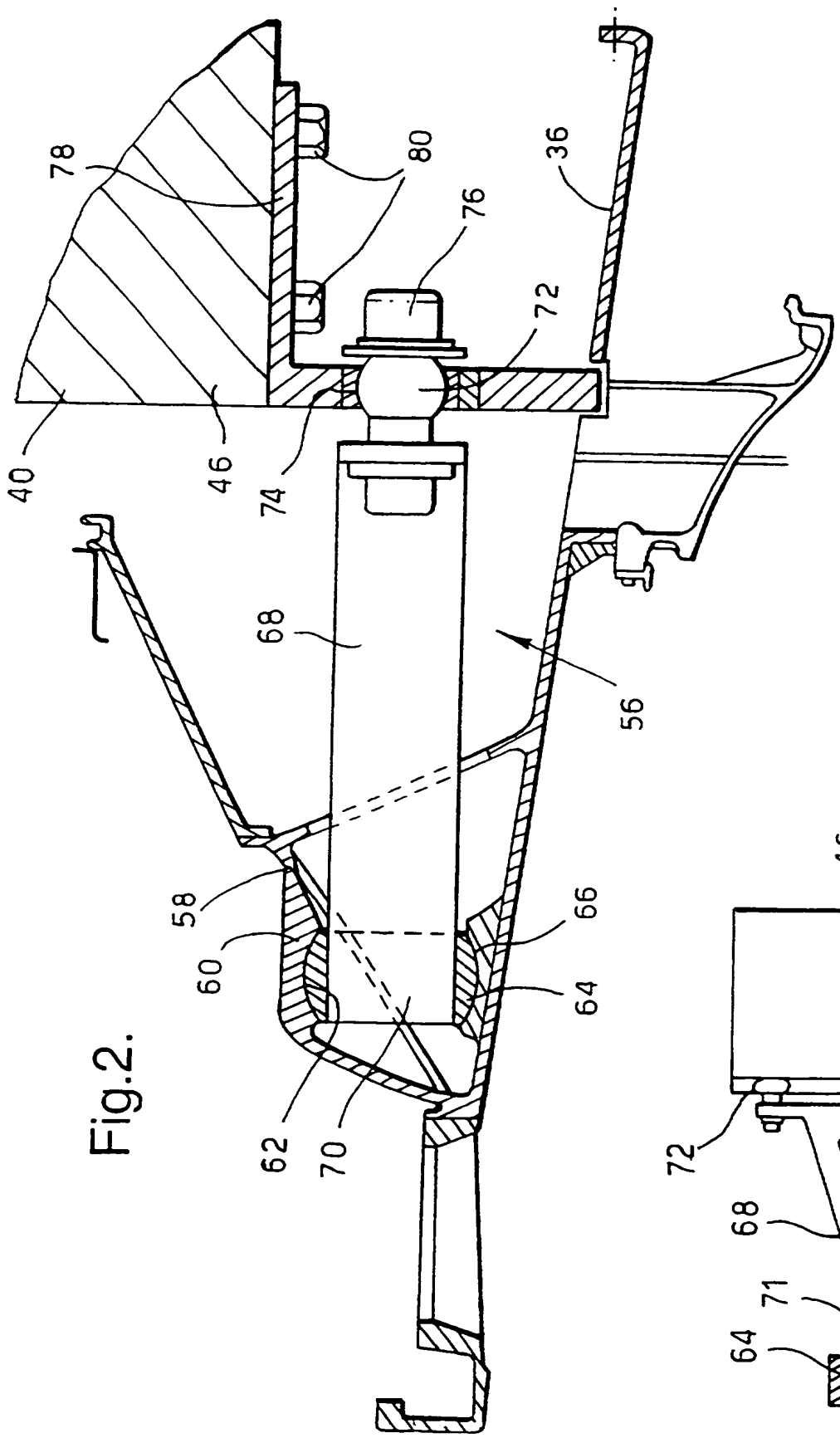
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Fig.2.

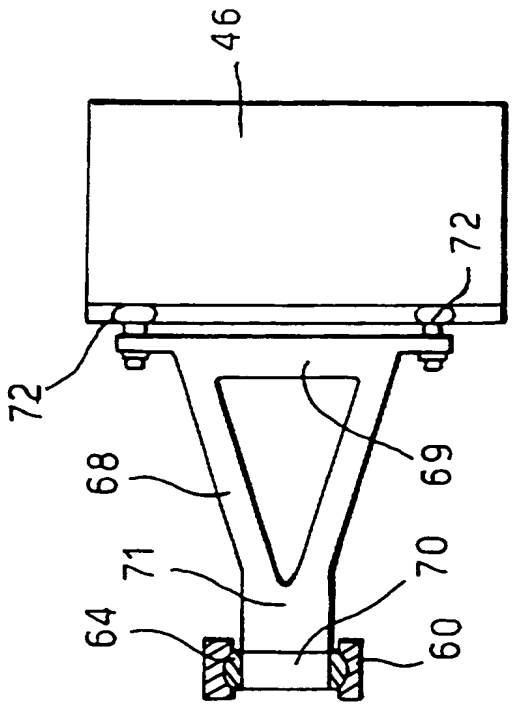
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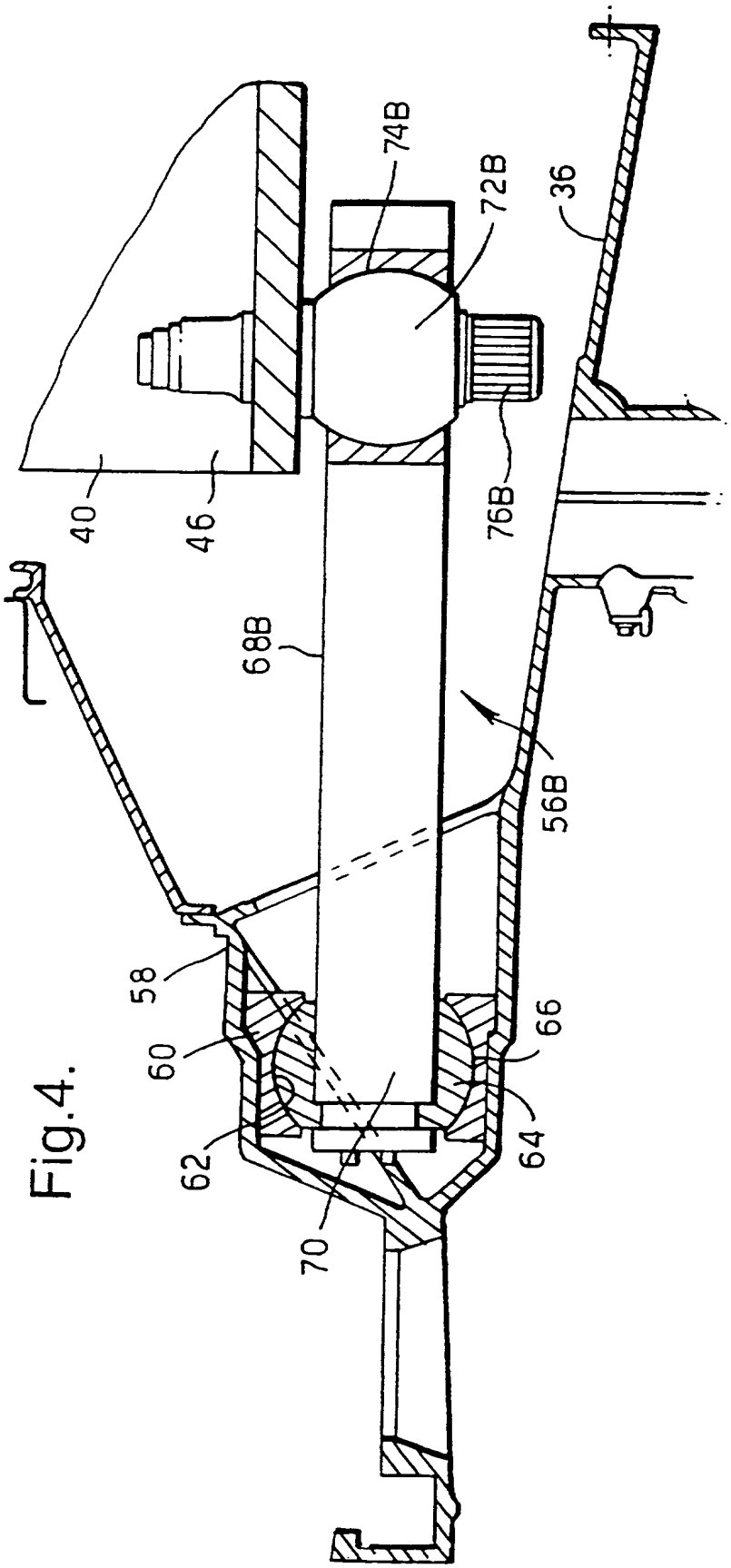
Fig.3.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72B
36
40
46
76B
68B
56B
58
60
62
66
64
70

Fig.4.

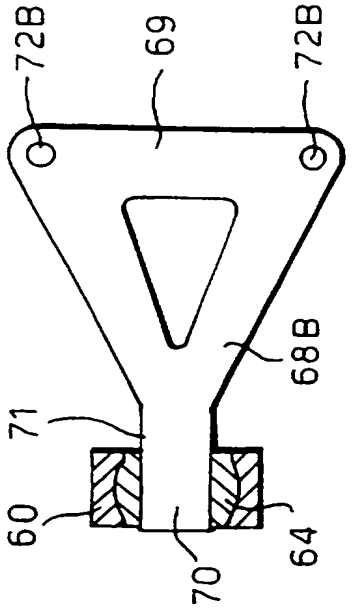
72B
69
72B
68B
71
60
64
70

Fig.5.

A MOUNTING FOR COUPLING A TURBOFAN GAS TURBINE ENGINE TO AN AIRCRAFT STRUCTURE

The present invention relates to a mounting for coupling a turbofan gas turbine engine to an aircraft structure.

In one conventional core mounted high bypass ratio turbofan gas turbine engine, in which the fan assembly is positioned upstream of the core engine, the engine is mounted onto an aircraft pylon by upstream and downstream mounting means. The upstream and downstream mounting means are positioned adjacent to the fan assembly and the turbines of the core engine respectively. Furthermore the fan casing of the turbofan gas turbine engine is supported from the core engine by support means. The upstream mounting secures the top dead centre of compressor casing to the pylon and transmits side and vertical loads. The downstream mounting secures the top dead centre of the turbine casing to the pylon and transmits side and vertical loads and torque. Thrust struts extend from the upstream mounting or the downstream mounting to the core engine casing.

In another conventional fan casing mounted high bypass ratio turbofan gas turbine engine, in which the fan assembly is positioned upstream of the core engine, the engine is mounted onto an aircraft pylon by upstream and downstream mounting means. The upstream mounting means is provided on the fan casing and the downstream mounting means is provided adjacent the turbines on the core engine casing. The upstream mounting secures the top dead centre of fan casing to the pylon and transmits side and vertical loads. The downstream mounting secures the top dead centre of the turbine casing to the pylon and transmits side and vertical loads and torque. Thrust struts extend from the downstream mounting to the core engine casing. Generally the fan casing mounting is positioned as far upstream as

possible to minimise bending of the core engine from fan casing intake aerodynamic loads.

A problem with the former arrangement is that the upstream mounting is prevented from being positioned as far in an upstream direction as possible because of engine structure and the requirement of the aircraft structure to clear the engine structure during engine changes. This may result in bending of the core engine and core casing.

In order to minimise core engine bending the upstream mounting must be positioned as far upstream as possible.

A problem with the latter arrangement is that the centre of gravity of the turbofan gas turbine engine is a relatively large vertical distance from the upstream and downstream mounting means where any side loads on the turbofan gas turbine engine are reacted. This may result in flutter in the wings of the aircraft.

In order to minimise wing flutter the vertical distance between the centre of gravity and the upstream and downstream mounting means must be relatively small to minimise roll torque, preferably the distance is zero.

The present invention seeks to provide a novel mounting for coupling a turbofan gas turbine engine to an aircraft structure which reduces, preferably overcomes, the above mentioned problems.

Accordingly the present invention provides a mounting for coupling a turbofan gas turbine engine to an aircraft structure, the turbofan gas turbine engine comprising a core engine and a fan assembly, the fan assembly comprising a fan and a fan casing, the core engine comprising compressor means, combustor means, turbine means and a core casing, an upstream core mounting connecting the core casing to the aircraft structure to transmit side loads only to the aircraft structure, the upstream core mounting comprising a first structure on the core casing adjacent the compressor means, the structure comprising a sleeve having a spherical inner surface, a bush having a spherical

outer surface locating coaxially within the sleeve, a second structure having a pin for locating coaxially in the bush and the second structure having laterally spaced connectors to secure the second structure to the aircraft structure to transmit side loads but not to transmit vertical loads to the aircraft structure.

Preferably the mounting comprises a fan mounting connecting the top dead centre of the fan casing to the aircraft structure to transmit pitch and vertical loads to the aircraft structure, an upstream core mounting connecting the core casing to the aircraft structure to transmit side loads only to the aircraft structure, a downstream core mounting connecting the core casing to the aircraft structure to transmit side and vertical loads and torque to the aircraft structure, thrust struts connecting the downstream core mounting and the core casing, the upstream core mounting comprising the first structure on the core casing adjacent the compressor means, the first structure comprising a sleeve having a spherical inner surface, a bush having a spherical outer surface locating coaxially within the sleeve, a second structure having a pin for locating coaxially in the bush, the second structure having laterally spaced connectors to secure the second structure to the aircraft structure to transmit side loads but not to transmit vertical loads to the aircraft structure.

Preferably the laterally spaced connectors are spherical connectors. The laterally spaced connectors may be pins extending laterally which locate in coaxial apertures in the aircraft structure.

Preferably the second structure is a triangular structure.

The present invention will be more fully described by way of example with reference to the accompanying drawings in which:-

Figure 1 shows a mounting for coupling a turbofan gas turbine engine to an aircraft structure according to the present invention.

Figure 2 shows an enlarged view of the upstream core mounting shown in figure 1.

Figure 3 shows a plan view of the upstream core mounting shown in figure 2.

Figure 4 shows an enlarged alternative view of the upstream mounting shown in figure 1, and

Figure 5 shows a plan view of the upstream core mounting shown in figure 4.

A turbofan gas turbine engine 10, as shown in figure 1, comprises in flow series an inlet 12, fan assembly 14, a compressor section 16, a combustion section 18, a turbine section 20 and an exhaust 22. The fan assembly 14 comprises a fan rotor 24 which carries a plurality of angularly spaced radially outwardly extending fan blades 26. The fan rotor 24 and fan blades 26 are enclosed by a fan casing 28 which defines a fan duct 30. The fan duct has an exhaust 32 at its downstream end. The compressor section 16, combustion section 18 and turbine section 20 form a core engine 34. The core engine 34 is enclosed by a core casing 36. The fan casing 28 is interconnected to the core casing 36 by a plurality of angularly spaced radially outwardly extending fan outlet guide vanes 38.

The turbofan gas turbine engine 10 is mounted onto an aircraft pylon 40 by a mounting described below. The pylon 40 has an upstream end 42, a downstream end 44 and an intermediate portion 46.

The upstream end 42 of the pylon 40 is connected to the fan casing 28 by a fan mounting 48. The fan mounting 48 transmits vertical loads from the fan assembly 14 and core engine 34 to the pylon 40.

The downstream end 44 of the pylon 40 is connected to the downstream end of the core casing 36 adjacent the turbine section 20 by a downstream core mounting 50. The

downstream core mounting 50 transmits side and vertical loads and torque from the core engine 34 to the pylon 40. A pair of thrust struts 52 connect points 54 on the core casing 36, either side of vertical plane through the engine axis A, adjacent the compressor section 16 to the downstream core mounting 50 and hence the pylon 40.

The intermediate portion 46 of the pylon 40 is connected to the core casing 36 adjacent the compressor section 16 by an upstream core mounting 56, which is shown more clearly in figures 2 and 3.

The upstream core mounting 56 comprises a first structure 58 adjacent the compressor section 16 of the core casing 36. The first structure 58 comprises an annular structure which is triangular in axial cross-section. The first structure 58 comprises a sleeve 60 and a bush 64 arranged at top dead centre of the core casing 36. The sleeve 60 has a spherical inner surface 62 and the bush 64 has a spherical outer surface 66 which locates coaxially, and can rotate, within the sleeve 60.

A second structure 68 has a pin 70 for locating coaxially in the bush 64. The second structure 68 is triangular in lateral cross-section. The second structure 68 has laterally spaced spherical connectors 72 which are secured to the second structure 68 by fasteners 76. The spherical connectors 72 locate in spherical shaped apertures 74 in an L-shaped bracket 78. The L-shaped bracket 78 is secured to the intermediate portion 46 of the pylon 40 by fasteners 80. The upstream core mounting 56 transmits side loads only to the aircraft structure 40 and does not transmit vertical loads to the aircraft 40 because of the spherical connectors 72. The second structure 68 extends axially upstream from the intermediate portion 46 of the pylon 40. The base portion 69 of the triangle of the second structure 68 is arranged to extend laterally of a vertical plane through the axis A of the turbofan gas turbine engine 10. The apex 71 of the triangle of the

second structure 68 is arranged substantially in a vertical plane through the turbofan gas turbine engine 10.

The upstream mounting 56 is easily removed from the intermediate portion 46 of the pylon 40, while remaining attached to the turbofan gas turbine engine 10 to allow engine changes by simply unfastening and removing the fasteners 80.

An alternative upstream core mounting 56B, as shown in figures 4 and 5, is substantially the same as that shown in figures 2 and 3. It differs in that the laterally spaced spherical connectors 72 locate in spherical shaped apertures 74B in the second structure 68B and the spherical connectors 72B are secured to the intermediate portion 46 of the pylon 40 by fasteners 76B. The upstream core mounting 56B transmits side loads only to the aircraft structure 40.

The upstream mounting 56B is easily removed from the intermediate portion 46 of the pylon 40, while remaining attached to the turbofan gas turbine engine 10 to allow engine changes by simply unfastening and removing the fasteners 76B.

A further alternative is to use a pair of coaxial pins which extend parallel to the base 69 of the triangle of the second structure 68. The pins locating in coaxial apertures in the intermediate portion 46 of the pylon 40 to transmit lateral loads but not to transmit vertical loads.

The advantage of the use of the mounting arrangement using fan mounting, upstream core mounting and downstream core mounting is that the fan mounting transmits vertical loads to the aircraft structure, the downstream core mounting transmits side and vertical loads (yaw and pitch) and roll torque to the aircraft structure, the upstream core mounting transmits side loads only to the aircraft structure and the thrust links transmit thrust loads from core engine to the downstream core mounting. The upstream core mounting is closer to the centre of gravity of the

turbofan gas turbine engine resulting in the transmission of lower side loads to the aircraft structure enabling the pylon and aircraft structure to be tuned to minimise flutter of the aircraft structure, for example the aircraft wings. The use of the sleeve with the spherical inner surface, the bush with the spherical outer surface, pin and axially extending triangular structure enables the axial separation of the upstream core mounting and downstream core mounting to be increased, by moving the mounting point further upstream, to reduce bending of the core engine and core casing.

Although spherical connectors have been described in the description it may be possible to use other connectors which will transmit side loads but not transmit vertical loads.

Claims:-

1. A mounting for coupling a turbofan gas turbine engine to an aircraft structure, the turbofan gas turbine engine comprising a core engine and a fan assembly, the fan assembly comprising a fan and a fan casing, the core engine comprising compressor means, combustor means, turbine means and a core casing, an upstream core mounting connecting the core casing to the aircraft structure to transmit side loads only to the aircraft structure, the upstream core mounting comprising first structure on the core casing adjacent the compressor means, the first structure comprising a sleeve having a spherical inner surface, a bush having a spherical outer surface locating coaxially within the sleeve, a second structure having a pin for locating coaxially in the bush and the triangular structure having laterally spaced connectors to secure the second structure to the aircraft structure to transmit side loads but not to transmit vertical loads to the aircraft structure.

2. A mounting as claimed in claim 1 wherein the mounting comprises a fan mounting connecting the top dead centre of the fan casing to the aircraft structure to transmit pitch and vertical loads to the aircraft structure, an upstream core mounting connecting the core casing to the aircraft structure to transmit side loads only to the aircraft structure, a downstream core mounting connecting the core casing to the aircraft structure to transmit side and vertical loads and torque to the aircraft structure, thrust struts connecting the downstream core mounting and the core casing, the upstream core mounting comprising first structure on the core casing adjacent the compressor means, the structure comprising a sleeve having a spherical inner surface, a bush having a spherical outer surface locating coaxially within the sleeve, a second structure having a pin for locating coaxially in the bush, the second structure having laterally spaced connectors to secure the

second structure to the aircraft structure to transmit side loads but not to transmit vertical loads to the aircraft structure.

3. A mounting as claimed in claim 1 or claim 2 wherein the laterally spaced connectors are spherical connectors.

4. A mounting for coupling a turbofan gas turbine engine to an aircraft structure substantially as hereinbefore described with reference to figures 1, 2 and 3 of the accompanying drawings.

5. A mounting for coupling a turbofan gas turbine engine to an aircraft structure substantially as hereinbefore described with reference to figures 1, 4 and 5 of the accompanying drawings.

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Application No: GB 0007441.9
Claims searched: 1-3

Examiner: Terence Newhouse
Date of search: 23 August 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): B7G(GJM)

Int Cl (Ed.7): B64D 27/00 27/26

Other: ONLINE: EPODOC, JAPIO, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	EP 0115914 A1	(BRITISH AEROSPACE), see figs 12 & 16 noting mounting component 45	1 at least
A	US 4917331	(BOEING), document shows an engine mounting which reduces flutter	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.